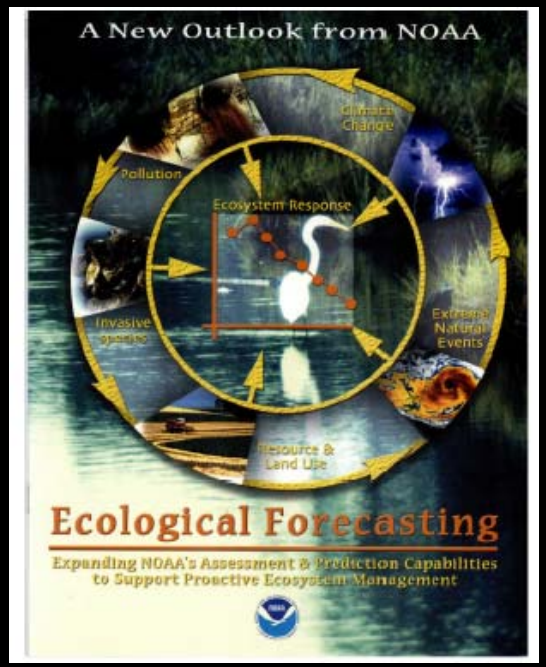
Ecological Forecasting



Extending NOAA's prediction and assessment mission to coastal and marine ecosystems.

Dr. Donald Scavia
National Ocean Service
National Oceanic and Atmospheric Administration
November 8, 2002

Outline

The Ecological Forecasting Context …

- What are they? How can they help?
- A few examples …

Thoughts for the Workshop …

- Set the science agenda to reduce forecast uncertainty.

Agencies and Academia Converging

Interagency Effort:

Predicting Ecosystem and Natural Resource Change.

CENR/Ecological subcommittee:

NSF, NOAA EPA, NASA DOI, USDA SI, DOE.

Academic Perspective:

Ecological forecasts: an emerging imperative.

Clark, et al. 2001 Science.

NOAA/NOS Concept

Connecting science and management

Ecological Forecasting
A synthesis Challenge

"In terms of conventional physics, the grouse represents only a millionth of either the mass or energy of an acre. Yet, subtract the grouse and the whole thing is dead."

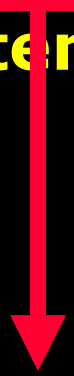
Aldo Leopold, 1948

"In anything at all, perfection is finally attained not when there is on longer anything to add, but when there is no longer anything to take away."

Antoine de Saint-Exupery, 1940

Definitions

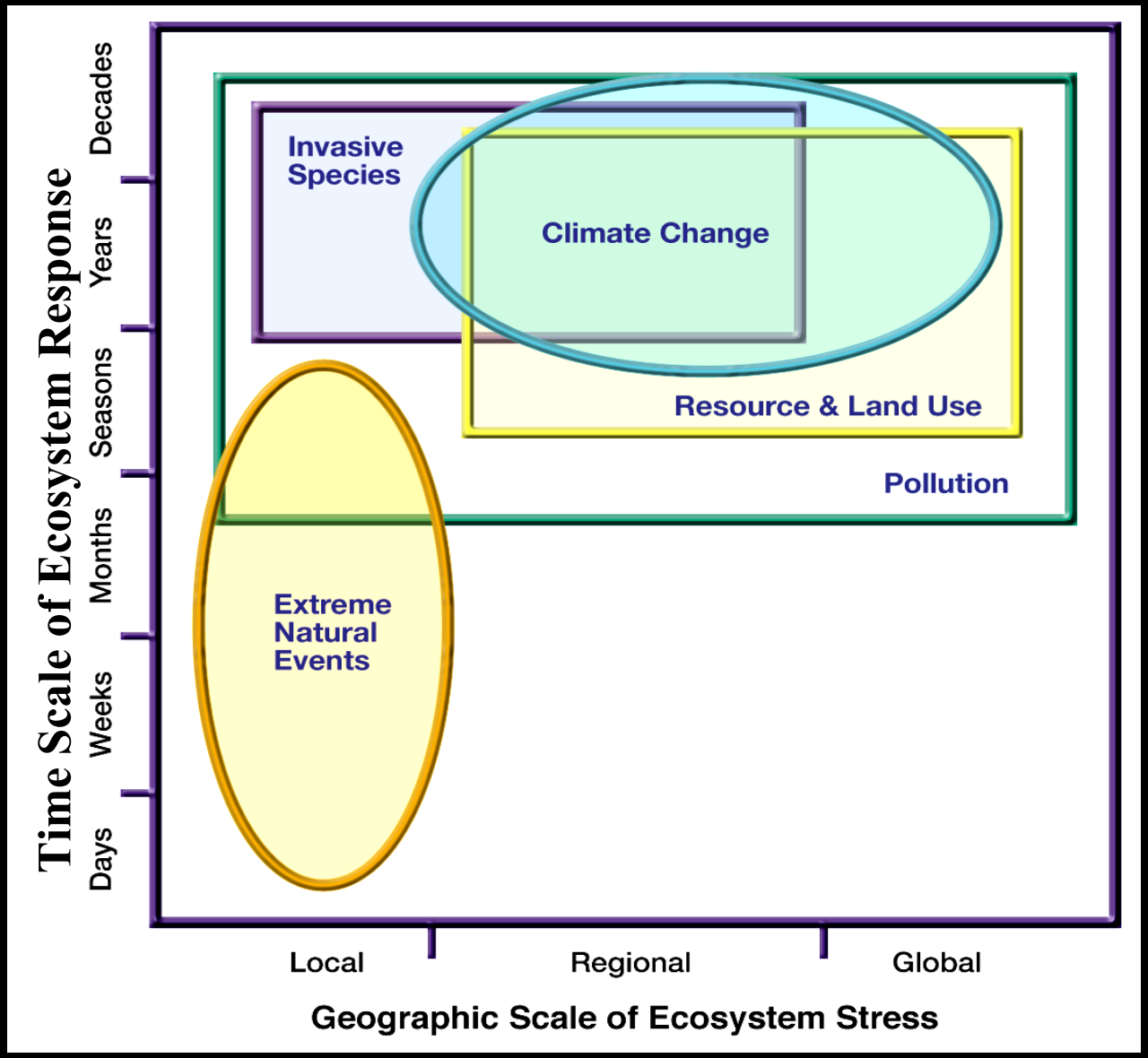
Ecological forecasts predict the impacts of biological, chemical, and physical change on ecosystems, ecosystem components, and people.



… can be the result of human action or natural processes

Drivers of Ecosystem Change

Different Time and Space scales.



From CENR

Focus on Two Classes

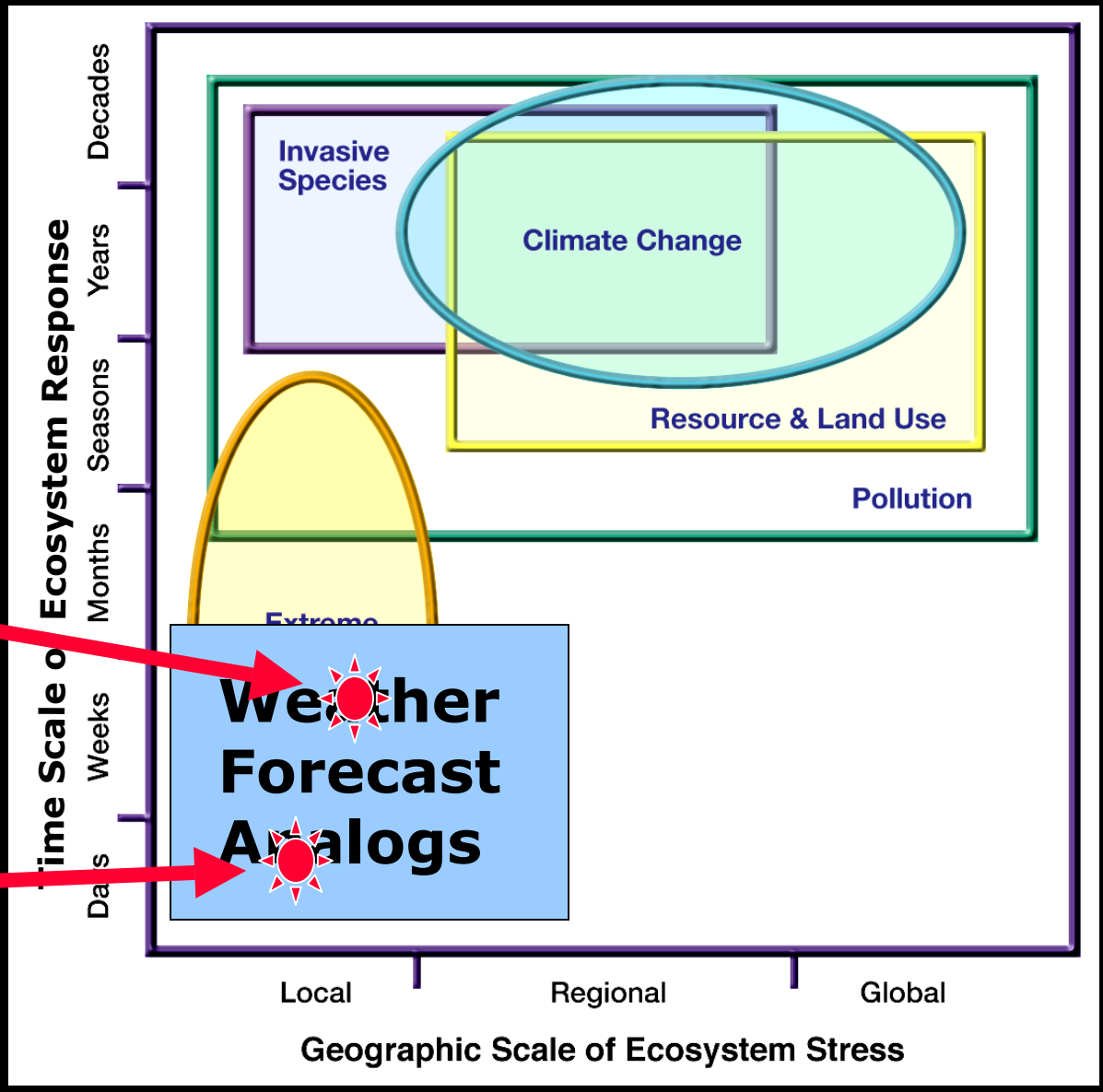
Weather Forecast Analogies

- Short-term, local scales

Weather Forecast Analogs

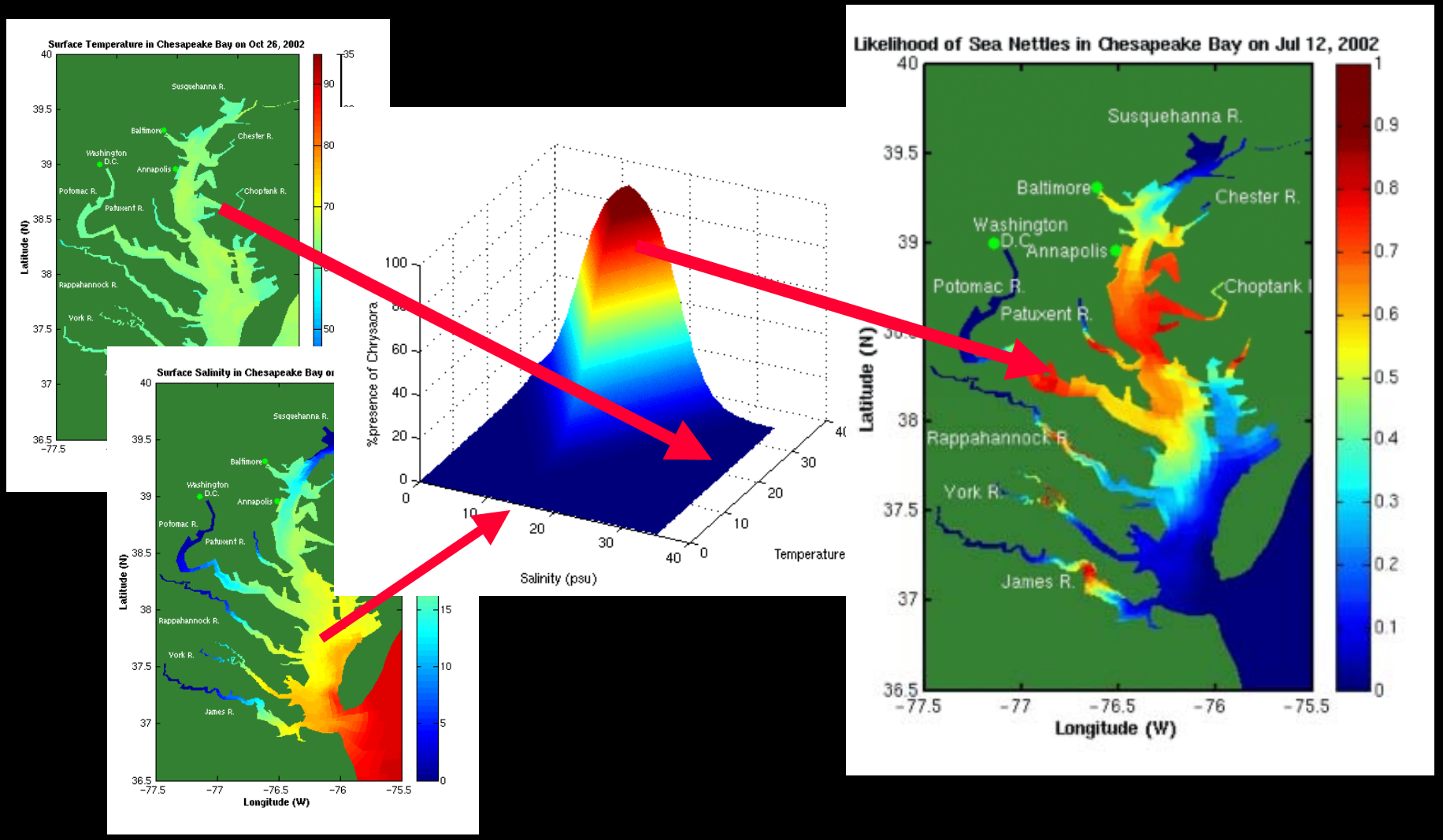
Chesapeake Bay Sea Nettle Nowcasts

Florida and Gulf of Maine HAB Forecasts



Sea Nettle Nowcasts

Developed by NESDIS, NOS, UMd, and VIMS

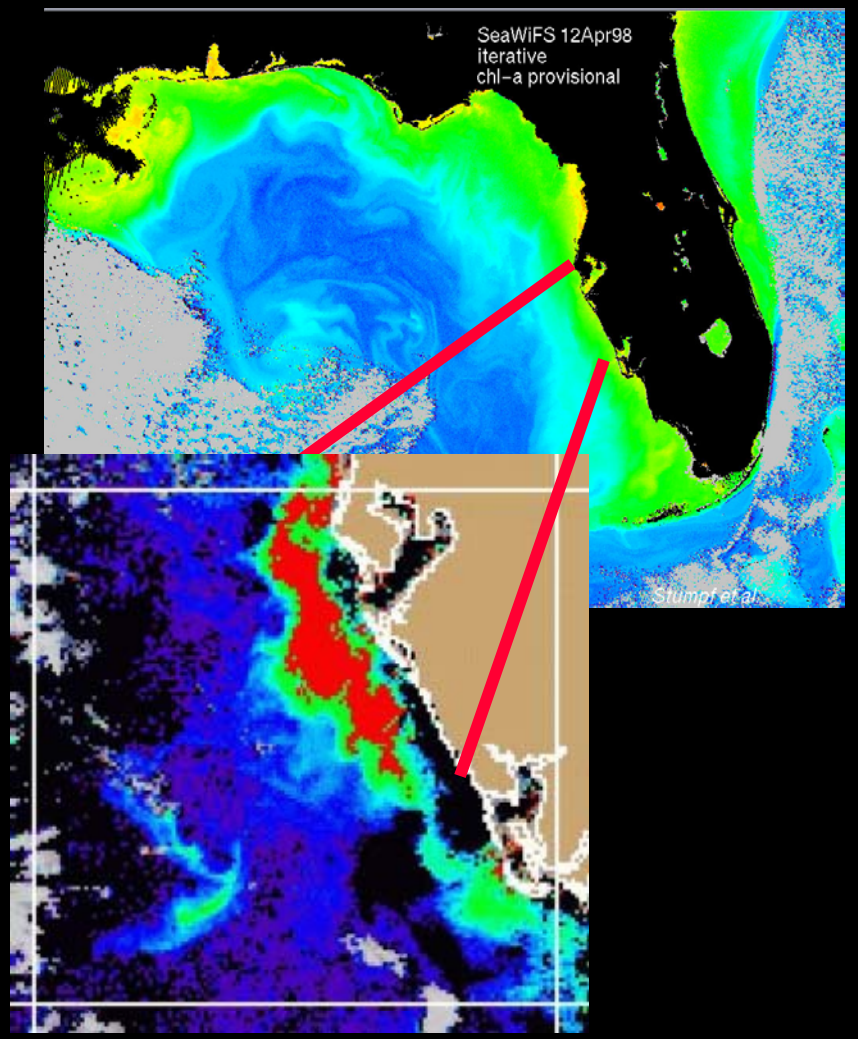


Gulf of Mexico HAB Forecasts

Once a bloom is detected, combine:

- **satellite tracking,**
- **in situ sampling**
- **bio-physical models**

provide trajectories and potential areas of land-fall.



Developed by NOS (NCCOS, CSC) and NESDIS CoastWatch

RED TIDE STATUS - SW FLORIDA

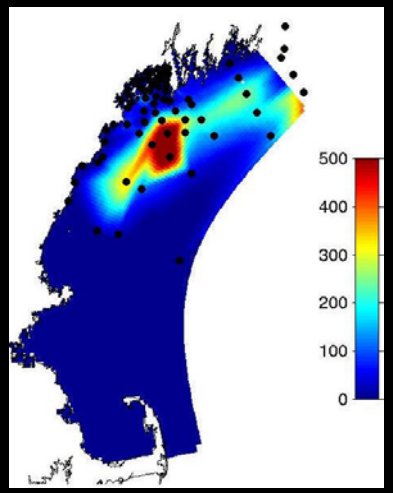
October 5, 2000

Initial Reports: G. breve was PRESENT at a few surface and bottom sites during ECOHAB research cruises off Sarasota on 9/11, 20, and 25. On 9/27, the NOAA National Ocean Service noted that satellite imagery data showed the "potential for bloom development" by early October. **The week of 10/04/00, G. breve concentrations within 5 miles of shore increased to bloom levels and monitoring along the SW coast began.** Monitoring will continue until concentrations return to normal.

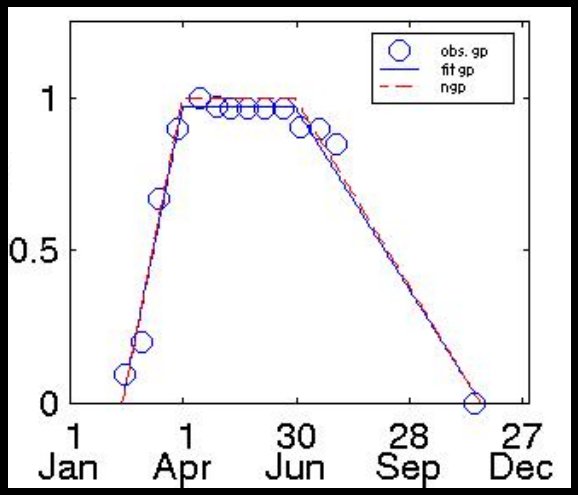
Gulf of Maine HAB

Alexandrium Dynamics Model

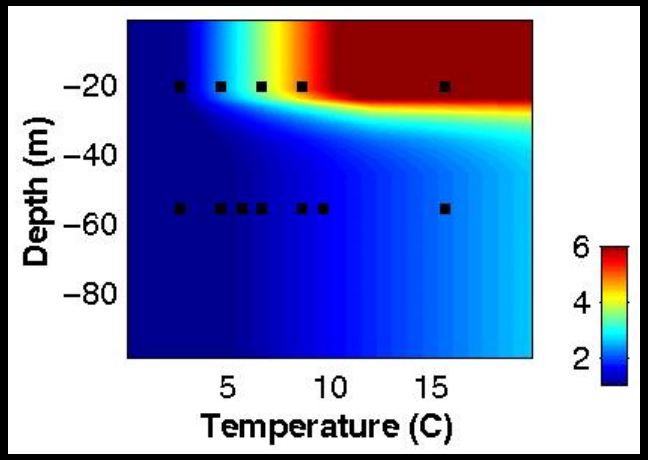
Cyst Dist. (# / cm^2)



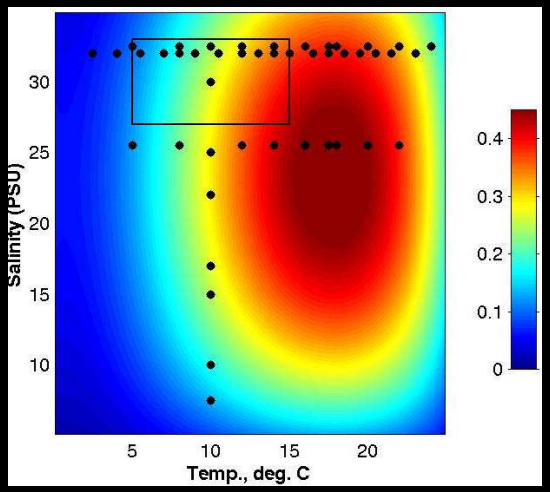
Endogenous Clock



Germ. rate (% / day)



Growth (T, Salinity)



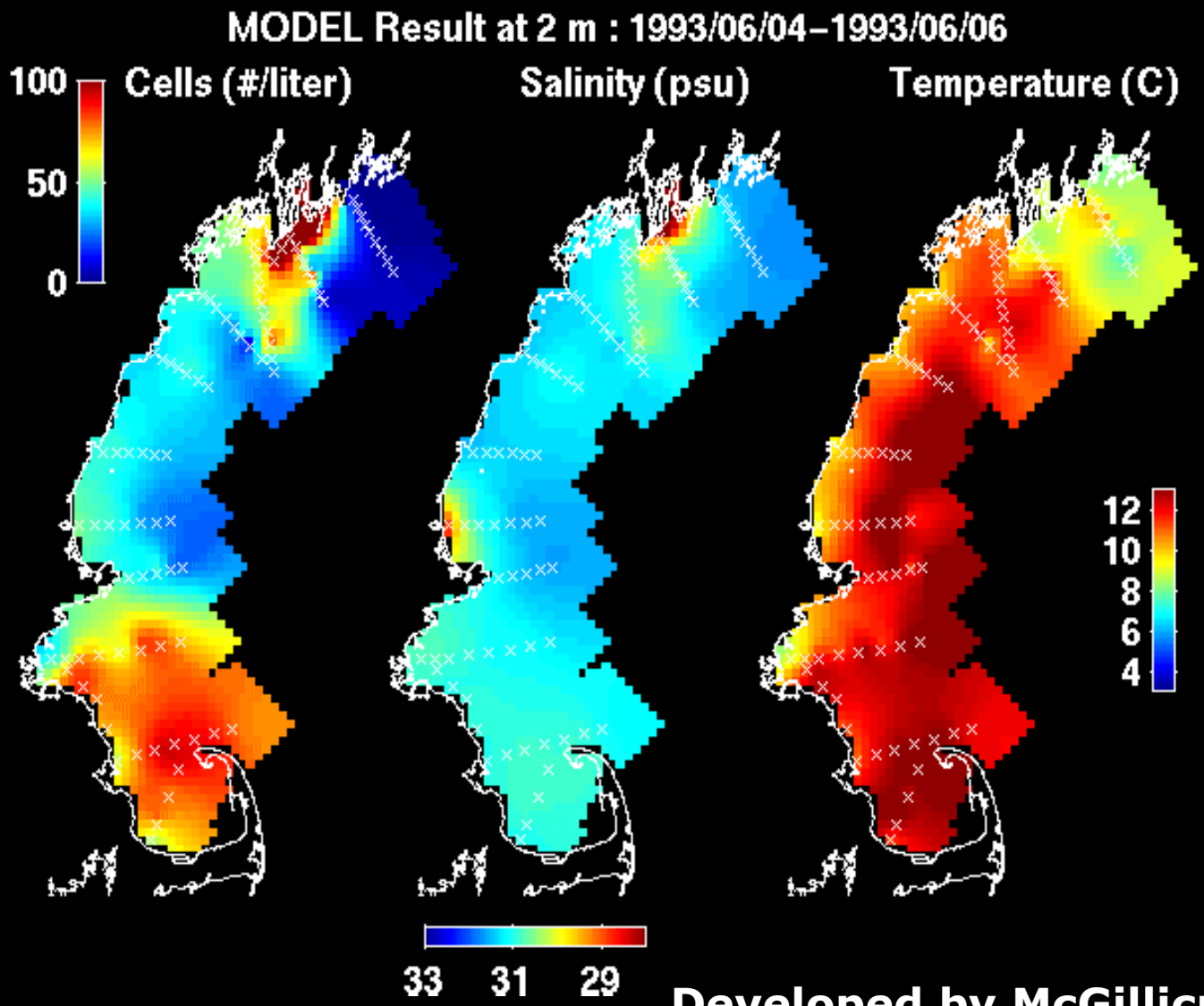
Growth = min (f(PAR) , g(T,S))

Upward swimming 10 m/day

"Mortality" = 0.1 per day

Developed by Anderson et al. through NOS/COP/ECOHAB

Alexandrium Simulations



Developed by McGillicuddy et al. through NOS/COP/ECOHAB

Focus on Two Classes

Integrated Assessment Contexts

Longer-term, regional scales

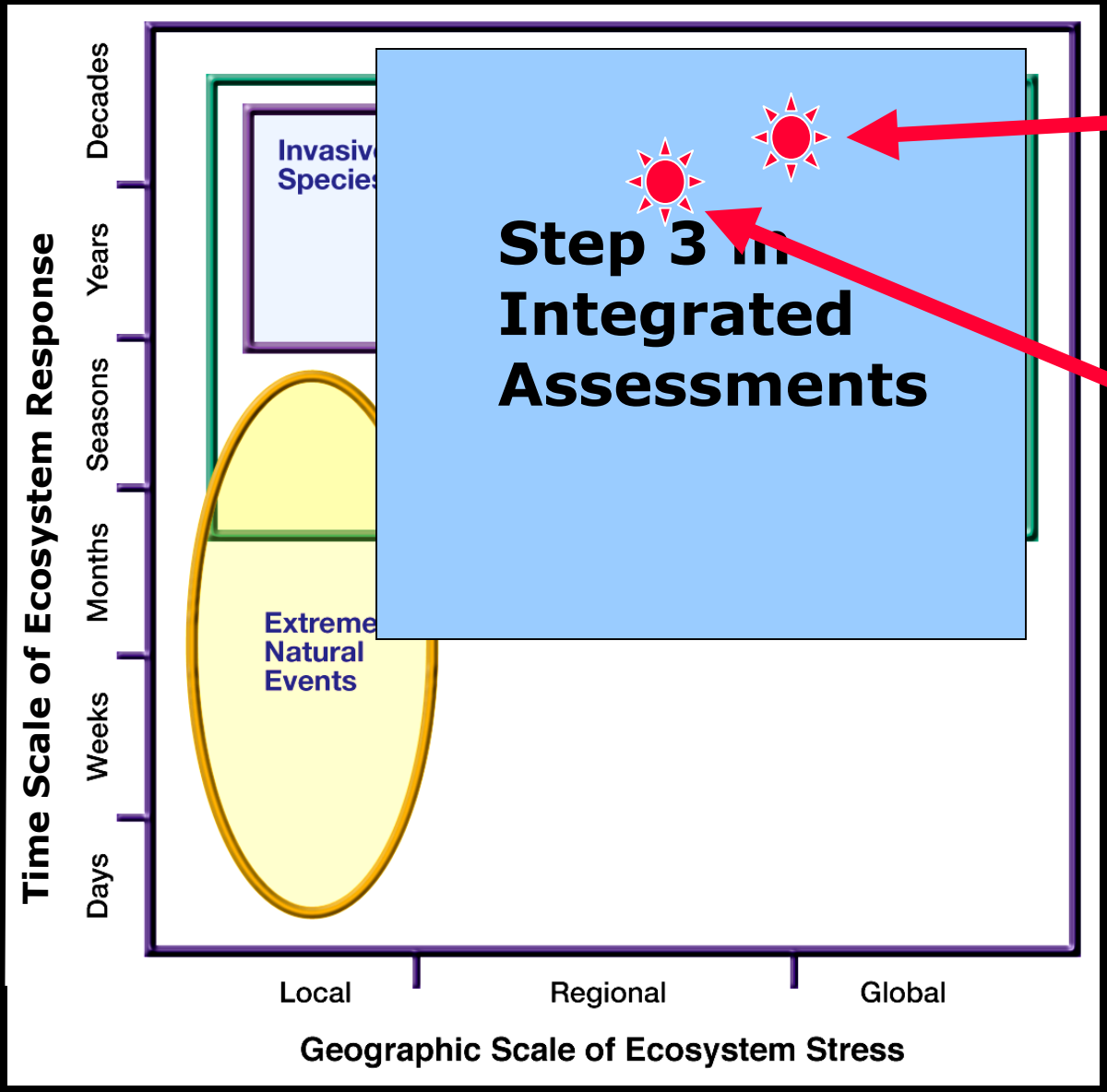
Integrated Assessments
A Formal bridge to policy

1. **Document Status and Trends**
2. **Describe Causes and Consequences of Trends**
3. ***3.*** **Predict Future Outcomes Under Action Options**
4. **Provide guidance for Potential Actions**

A key weak point in most Integrated Assessments is Step #3:

Ecological Forecasting

Input for Assessments



Water Allocation impacts on oysters.

MS Basin Land Use impacts on Gulf hypoxia.

Changes in Freshwater Flow
Impacts on Apalachicola Bay Oysters

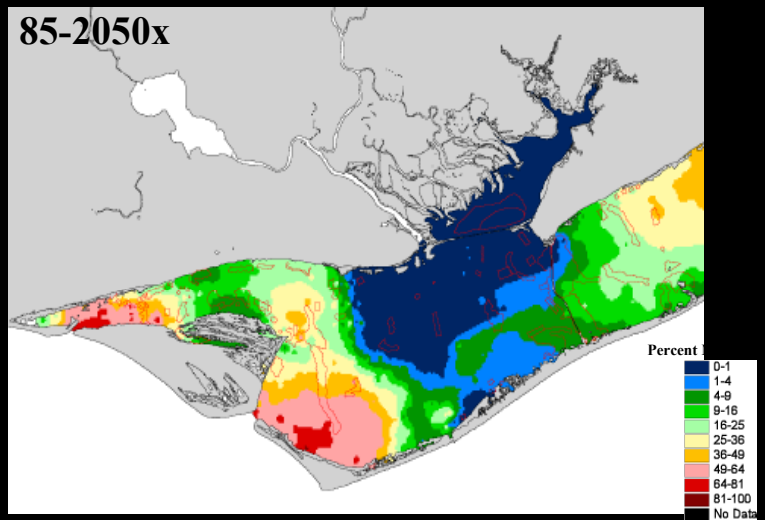
Three-state dispute over water:

Florida, Georgia, Alabama

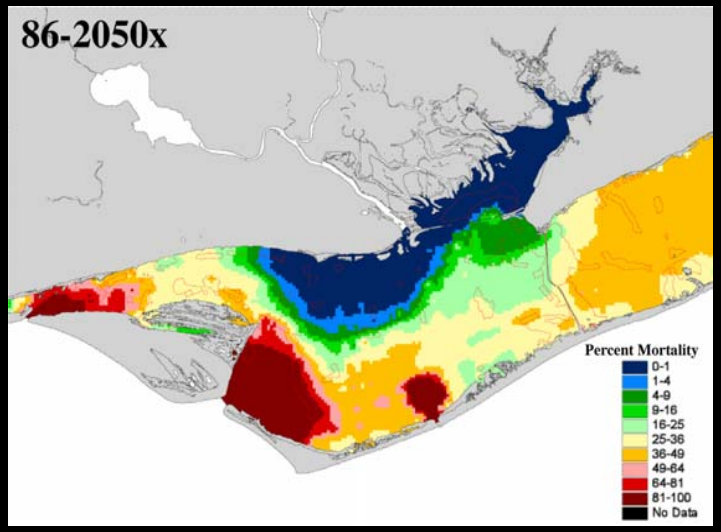
Biophysical Model (*Monaco et al*):

hydrology, hydrodynamics, salinity, temperature, oyster mortality

Forecast effects of meeting human 2050 demands …



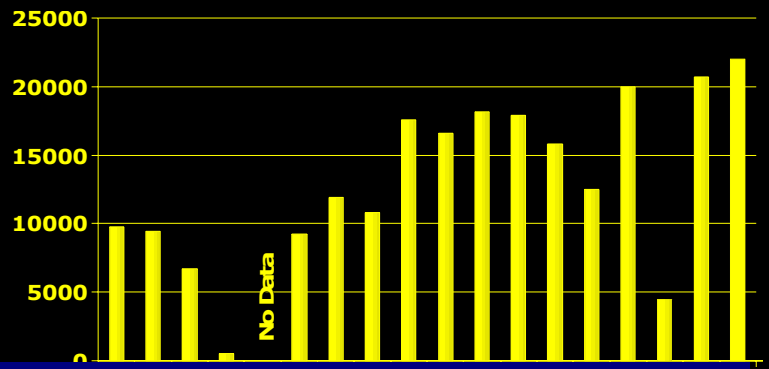
… under normal climate



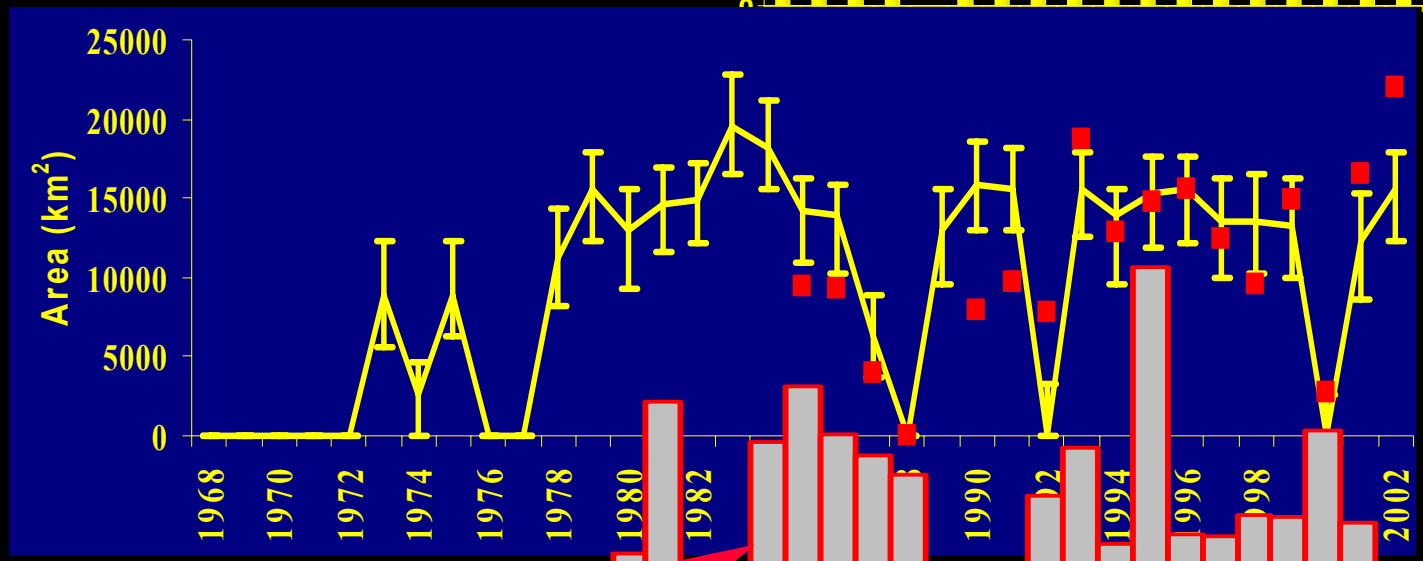
… under dry climate

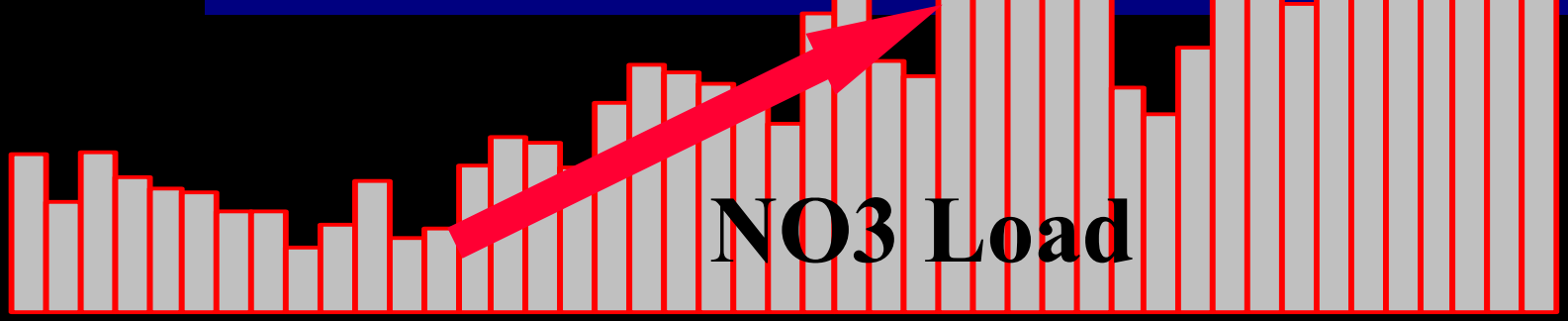
Predicting Gulf Hypoxia

Observed Hypoxia



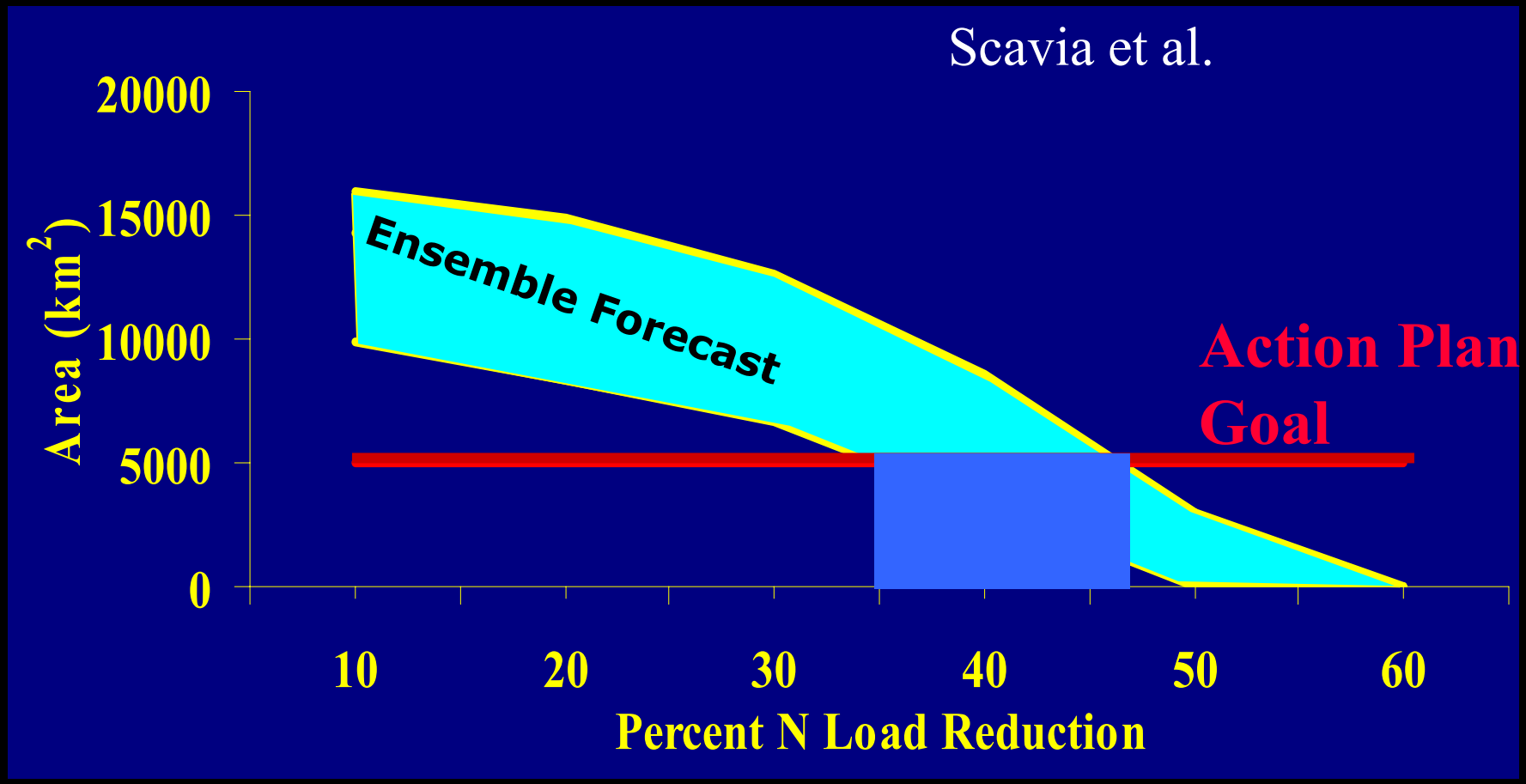
Simulated Hypoxia





Predicting Gulf Hypoxia

What load reduction is needed?



Benefit of Focusing on Forecasts

Forecasts ...

... improve decisions by "knowing" the future.

... communicate science products
to the general public and the Congress
among scientists, policy makers, managers.

... integrate & prioritize science agenda.

- what/where to monitor?
- what research?
- which model development?

Thoughts for the Workshop

Identify the user(s) …

… real ones, not "decision makers".

Understand what they want …

… don't assume. Physics is rarely enough.

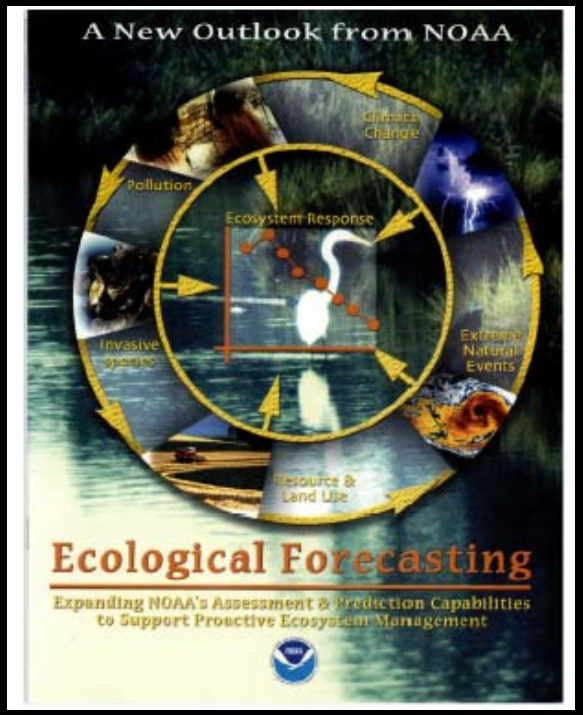
Frame the forecasts in response …

… agree on content and format.

Build required research program …

… build capability and reduce uncertainty.

Ecological Forecasting



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